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The Bulletin

Habitat Preservation News

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# Chemical Hazards to Fish and Wildlife

The environmental hazards of chemical contaminants have received a great deal of publicity since Rachel Carson's book, **Silent Spring,** first focused national attention on the problem in 1962. The Fish and Wildlife Service (FWS) has long been a leader in investigating the effects of chemical contaminants on fish, wildlife, and their habitat. The Environmental Contaminants Evaluation (ECE) Program has responsibility within FWS for developing, disseminating, and using information on chemical hazards.

The ECE Program has two major components—field operations and research. An ECE field operations staff is located in each of the seven FWS regions. Their major activities include investigation of localized contaminant problems, response to spills of oil and hazardous substances, review of FWS-sponsored pesticide use programs, sample collections for the National Pesticide Monitoring Program, and technical assistance on contaminant issues to other FWS programs, other Federal and State agencies, and the public. FWS shares responsibility with other Federal agencies, under the Fish and Wildlife Coordination Act and the National Environmental Policy Act, for insuring that natural resource development takes place in an environmentally acceptable manner. Regional ECE staff play a major role in the FWS responsibilities under these laws by providing expertise on contaminants in the review of environmental impact statements and permit applications.

Contaminant research is conducted at three major FWS laboratories: the Patuxent Wildlife Research Center in Laurel, MD; the Columbia National Fishery Research Laboratory in Columbia, MO; and the Great Lakes Fishery Laboratory in Ann Arbor, MI. Each of these centers, laboratories, and their field stations conducts research designed to assess the hazards of chemical contaminants to fish and wildlife. The contaminant information developed by research is used by FWS field staff, Federal and State regulatory agencies, natural resource managers, industry, and the public.

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Fish and Wildlife Service

**U.S. Department of the Interior**



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**Chemical Hazards**
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Prediction of the environmental hazards of chemicals has always been a priority of the ECE Program. Ideally, this anticipatory approach would provide decision-makers with the information necessary to avoid adverse effects from environmental contaminants. Unfortunately, anticipation does not always lead to prevention. In the case of DDT, Service scientists showed that DDT residues caused eggshell thinning in birds and repeatedly predicted that this would lead to serious declines in some bird populations. However, many years passed before regulations were implemented to remedy the problem, and several of the most vulnerable birds, including bald eagles, brown pelicans, and peregrine falcons, are now endangered.

The contaminant problems of the 1970's were so overwhelming that FWS predictive research yielded to pressures to solve more immediate problems. Consequently, the contamination of the environment with polychlorinated biphenyls (PCB's) and mercury went undetected until after severe environmental consequences had occurred. Eventually, evidence developed by FWS research and others lead to regulations curtailing the use of PCB's and mercury, just as in the case of DDT, but the problems could have been prevented.

The anticipatory approach has proven successful. Researchers at FWS laboratories have worked with U.S. Department of Agriculture scientists to identify unusually hazardous insecticides and develop safer alternatives, including chemical and nonchemical pest control methods. Service toxicologists demonstrated an acute hazard to fish from exposure to low levels of certain substitutes for PCB's, and industry responded by curtailing use of these chemicals. Data developed by FWS scientists also demonstrated to a chemical manufacturer that purified pentachlorophenol (a biocide and wood preservative) produced by a new process was significantly less toxic to fish than the old product. Researchers at FWS laboratories are constantly developing improved methods for detecting environmental contaminants and contaminant-induced stress in fish and wildlife. These methods will simplify testing procedures and permit earlier identification of chemical hazards.

Current research thrusts include: hazard assessment of contaminants resulting from energy development and mining; development of sensitive biological indicators of contaminant-induced stress in fish and wildlife; toxicity testing of new pesticides; studies of contaminant involvement in the decline of the striped bass fishery; and investigations of the effects of acid precipitation on fisheries of the Northeastern and Upper Midwestern States.

To insure that the large amount of data generated by research is effectively used, it is first necessary to understand which contaminant data are actually needed and how they are to be used. Thus, the ECE research program is driven by specific information needs identified by ECE operations personnel, by other FWS programs, and by other natural resource managers. Once information meeting the needs is gathered, it is packaged in an appropriate format and transferred to the information user. Application of the information invariably identifies additional information needs, which are then fed back to the ECE research program.

This issue of the **Habitat Preservation News** contains articles on: a contaminant monitoring program for fish and wildlife; pollution from agricultural chemicals; FWS response to oil and hazardous substance spills; impact of chemical contaminants in dredged material; and toxicological effects of oil on aquatic birds.

# Monitoring Fish and Wildlife for Environmental Pollutants

The Fish and Wildlife Service (FWS) monitors contaminant residues in wild birds and freshwater fish as part of its Environmental Contaminant Evaluation (ECE) Program. The FWS monitoring answers two basic questions: how do levels of pollutants in fish and wildlife vary according to geographic regions, and what changes are occurring over time? To provide these answers, monitoring networks for freshwater fish and birds were established in the mid-1960's.

Monitoring of chemical residues in freshwater fish began in 1967. Currently, fish are sampled at 110 stations throughout the United States. Collections are made at half of the stations one year, the other half the next year. Fish samples include bottom-dwelling species, such as carp, suckers, and catfish, and predaceous species, such as trout, walleyes, and bass.

Two bird species, the terrestrial starling and the aquatic mallard,

are used to monitor chemical residues in wildlife. The black duck is sampled in some Northeastern States where the mallard is less abundant. Starling monitoring began in 1967, and the birds are collected every 3rd year at 140 predetermined locations throughout the contiguous 48 States. Contaminant residues in ducks have been measured every 3 years since 1965 by analyzing duck wings collected from each major flyway during the FWS harvest survey. Research has shown that residue levels in duck wings reflect those of the entire body.

Fish and bird samples are analyzed for organochlorine pesticides such as DDT, dieldrin, and toxaphene and for chemically related compounds such as polychlorinated biphenyls (PCB's). Fish samples also are analyzed for heavy metals including lead, cadmium, arsenic, mercury, and selenium.

Pronounced regional differences in the levels of chemical contaminants have become evident in both fish and birds. Not surprisingly, the highest contaminant levels occur in the most densely populated, farmed, and industrialized areas. The pesticide DDT and its metabolite DDE have been the most prevalent fish and wildlife contaminants, although levels of DDE declined in both fish and birds with the decrease in DDT use in the United States and its ultimate ban in 1972. Levels of PCB's, however, have declined only slightly despite voluntary curtailment in the early 1970's and subsequent regulations to reduce discharges into lakes and streams. Fish monitoring has shown that intense use of the insecticide toxaphene in the 1970's resulted in potentially dangerous levels in cotton-producing regions and areas of the Great Lakes.

**Beach seining is done to gather young-of-the-year striped bass in the Potomac River. Stripers from four watersheds are being analyzed for contaminant residues and possible effects on growth and development.**

The FWS monitoring program thus identifies problem chemicals and geographical areas and measures long range trends on a nationwide basis. The hazard of the levels that are found is evaluated in the ECE research program through ecological and experimental studies. For example, laboratory studies at the Columbia National Fishery Research Laboratory, Columbia, MO, have shown that increasing residues of organachlorine chemicals in fish are correlated with a decrease in bone strength, which can lead to structural deformities in the fish.

The effects of contaminants on wildlife are studied at the Patuxent Wildlife Research Center, Laurel, MD, in ecological and experimental studies designed to elucidate how contaminants affect populations, reproductive behavior, and physiology. Research at Patuxent has defined the brain levels of certain organochlorine pesticides causing death in birds and the levels in eggs that suggest reproductive problems in sensitive birds. This information was put to practical management use within the last year when mortality and lowered reproductive success of Canada geese in Oregon and Washington were shown to be the result of consumption of heptachlor-treated seed. Heptachlor is an organochlorine pesticide. Regulatory changes were agreed on by FWS and State agencies to protect the geese without increasing damage to grain.

For additional information on the monitoring of environmental contaminants, contact:

Joel Jacknow
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior
Washington, DC 20240

or

Bernard Berger
Division of Fishery Ecology Research
Fish and Wildlife Service
U.S. Department of the Interior
Washington, DC 20240

# The Interaction between Agricultural Chemicals and Fish and Wildlife

Cornfields, pine forests, orange groves, pastures, and most other agricultural lands are treated with agricultural chemicals for control of weeds, insects, and other pests. Many of these chemicals pose potential hazards to fish and wildlife through direct toxicity, accumulation in higher trophic levels, or degradation of habitat.

Research in the Environmental Contaminants Evaluation (ECE) Program of the Fish and Wildlife Service (FWS) has helped to ensure that the safest chemicals are used. The task of evaluation continues as chemicals and use patterns change. For example, the use of DDT was banned in 1972. Two other organochlorine pesticides, dieldrin and heptachlor, also are being phased out. Instead, the use of organophosphate and carbamate pesticides, often combined with other methods of control, is increasing. The newer compounds are generally less persistent and more readily excreted than the persistent organochlorines. However, many are acutely toxic; others may metabolize to more toxic forms and persist long enough to cause mortality of wildlife and fish. For example, gulls in Texas carried insects from a parathion-treated field to their young at distant nests, killing the offspring in some cases. Little is known about the metabolism and effects on wildlife of many of these widely used compounds. To determine which chemicals are least harmful, studies are being conducted on a variety of wildlife species, such as mallards, barn owls, bobwhite quail, starlings, tadpoles, and several kinds of fish. Since all species do not respond alike, multiple testing is required.

Epidemics of spruce budworm continue to plague coniferous forests, especially in the Northeast. In recent years, more than 1 million acres of forests have been sprayed annually with insecticides in Maine alone. Scientists in ECE research have cooperated with the U.S. Forest Service in evaluating the hazard of these forest insecticides. Eventually, relatively safe pest control methods may be developed.

Another concern is the growing use of herbicides in coniferous forests to suppress growth of competing hardwoods. Based on past and projected use, aquatic contamination by herbicides could be severe and will require continual observation and hazard evaluation. Scientists at the FWS Columbia National Fishery Research Laboratory (CNFRL) are currently evaluating the effects of these herbicides on fish in forest streams.

**Dieldrin continues to cause great blue heron mortality years after the chemical was banned.**

Joint research by FWS and the U.S. Department of Agriculture (USDA) has demonstrated that a parasite is an effective nonchemical control agent for grasshoppers on western rangeland. Malathion has been shown to be an effective pesticide and to hold little hazard for wildlife. However, grasshopper outbreaks in the past 2 years have stimulated pressures to permit the use of endrin, a pesticide highly toxic to fish and wildlife. Continued joint efforts between FWS and USDA are essential to prevent resumption of use of such toxic substances.

Herbicides are used extensively to control weeds and brush in the Northwest. Many of the weed species are concentrated along streams where the waters carry the seeds. Often, more than one herbicide is used to control these weeds, and some herbicide combinations could produce greater than additive toxicity (synergism), resulting in an unexpected hazard to fish. Research is underway at CNFRL to determine the susceptibility of fish to different combinations of herbicides, and to identify and prevent the use of hazardous combinations.

Herbicides also are used in no-till agriculture, reducing populations of weeds that provide food and cover for wildlife. With the no-till method, the soil is harrowed—rather than plowed—be-

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**The Interaction**
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fore planting the crop, and herbicides are applied to suppress weed growth. In addition to possible contamination from herbicides, this results in loss of food and cover on farmlands, which in the past provided valuable habitat for wildlife.

Irrigation water from agricultural lands is a source of environmental contaminants in western streams and lakes. This pollution is primarily from pesticides, fertilizers, and sediment (soil) that drain into irrigation waters and eventually into natural streams. All of these materials can be harmful to aquatic life. Intensively irrigated areas, such as the Central and Imperial Valleys of California and the Columbia Basin of eastern Washington, are particularly vulnerable. Over 200,000 miles of water conveyance channels, millions of acre-feet of water in storage reservoirs, and millions of irrigated acres drain into natural waters in 17 Western States. Scientists at CNFRL are evaluating the effect of contaminants in these irrigation return flows on fishery resources.

Striking incidents of agricultural chemical poisoning have occurred. For example, carcasses of 200 ringbilled gulls, cattle egrets, and long-billed curlews were found adjacent to a field that had been treated with a pesticide 2 days earlier and then irrigated. Laboratory tests of the dead birds at the Patuxent Wildlife Research Center showed that mortality was due to parathion, a highly toxic organophosphorus pesticide.

Laboratory research is directed toward evaluating the relative toxicities of agricultural chemicals to fish and wildlife; developing methods to diagnose mortality; determining whether there may be subtle effects on growth, reproduction, or behavior as a result of repeated exposures; and recommending the safest chemicals or nonchemical control methods.

**This irrigation canal is choked with nuisance aquatic weeds, a typical Western States agricultural irrigation problem. The Fish and Wildlife Service is studying the impact of herbicides used to control these weeds.**

For additional information on FWS research on agricultural chemicals contact:

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Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior
Washington, DC 20240

or

Bernard L. Berger
Division of Fishery Ecology Research
Fish and Wildlife Service
U.S. Department of the Interior
Washington, DC 20240

# FWS Response to Oil and Hazardous Substances Spills

Approximately 10,000 oil spills occur in the inland and coastal waters of the United States each year. There are roughly 3,500 additional spills of other hazardous materials, about half of which reach navigable waters. Typical causes of spills include barge and tanker collisions and groundings, train derailments, pipeline and storage tank ruptures, and well blowouts. Such accidents frequently occur in or along inland and coastal waters, which serve as spawning and nursery grounds for fish and shellfish, as breeding and feeding areas for waterfowl and shore birds, and as critical habitat for endangered species. The Fish and Wildlife Service (FWS) has Federal responsibility for protecting these species and habitats in the event of oil and hazardous chemical spills.

Ultimate responsibility for spills rests with the spiller. However, the responsible party is often unknown or unable or unwilling to clean up a spill and mitigate damages. In such cases, spill re-

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**FWS Response**
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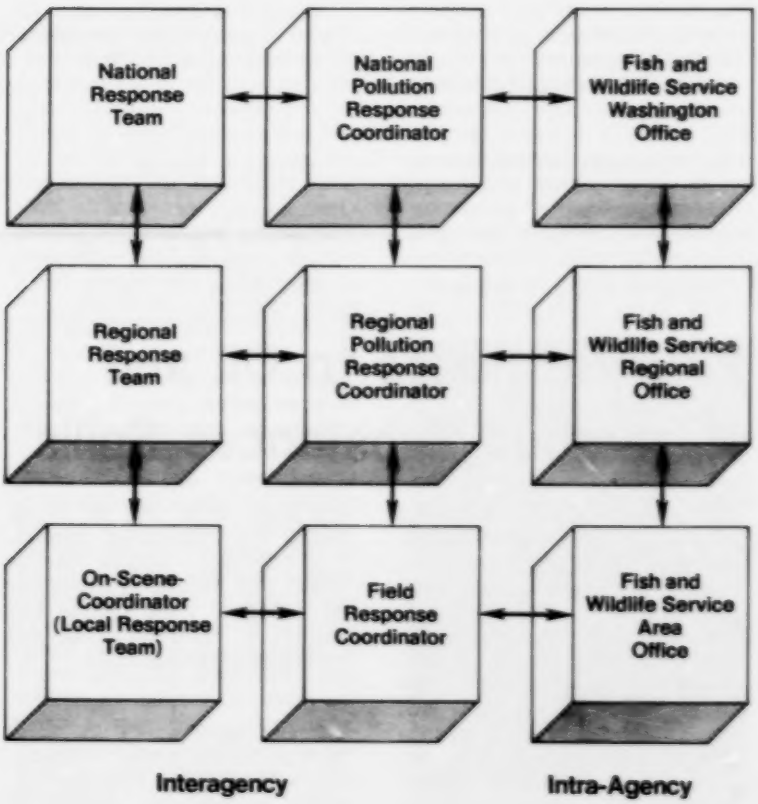
sponse becomes the responsibility of Federal, State, and local agencies.

The National Oil and Hazardous Substances Pollution Contingency Plan was developed to coordinate the activities of these agencies to ensure effective spill response. The plan, recently revised, establishes a National Response Team and Regional Response Teams whose primary members are: the U.S. Departments of the Interior, Defense, Transportation (U.S. Coast Guard), Commerce, Energy, State, Justice, Health and Welfare, Labor, and Agriculture; the U.S. Environmental Protection Agency (EPA); and the Federal Emergency Management Agency.

Federal activities at each spill are coordinated by an On-Scene Coordinator (OSC) from either EPA or the Coast Guard. The key to organized, effective spill response is contingency planning, which ensures that the appropriate personnel and equipment are available and prepared to respond on short notice.




**Flowchart of notification and coordination pathways for Fish and Wildlife Service response to pollution incidents.**

FWS, as representative of the Department of the Interior, is responsible for providing a member on the National and Regional Response Teams and advising the teams and OSC concerning protection of fish and wildlife, including endangered species and their habitat. In addition, FWS personnel coordinate Federal response should they be the first Federal representatives at a spill scene.

To fulfill these responsibilities, FWS published its **Pollution Response Plan for Oil and Hazardous Substances** in 1977. The FWS Plan establishes Regional Response Coordinators in each FWS region who oversee the activities of Field Response Coordinators (FRC). Each FRC responds to all spills within a given geographic area that endanger fish and wildlife resources. The accompanying flowchart illustrates the complex coordination involved in spill response.

A Regional Response Plan has also been prepared for each FWS region. This plan specifies responsibilities for regional personnel, identifies fish and wildlife resources vulnerable to spills, gives guidelines for dispersing or rehabilitating wildlife, and outlines the very important notification and coordination process.

The degree of Federal and FWS response is, in part, a function of the size of the spill, but the hazard to fish and wildlife resources is not strictly a function of spill size. The site of the spill, toxicity of the substance spilled, species and habitat affected, climatology, and season all determine the potential environmental damage. Hazardous chemicals pose a special problem due to the potential risks to human health. No FWS employee is permitted to jeopardize his or her safety, and, in the

case of very hazardous chemicals, FWS spill response is limited to remote communication with properly trained and equipped response personnel.

After human safety, FWS priorities for spill responses are:

1. To protect endangered species and their habitats. Where advisable, the rescue and rehabilitation of individual animals will be carried out.

2. To minimize the immediate impacts on susceptible fish and wildlife populations for which FWS has management responsibilities. These activities may include dispersing birds and other wildlife and advising the On-Scene Coordinator of the need to protect particularly valuable wildlife and fish habitat.

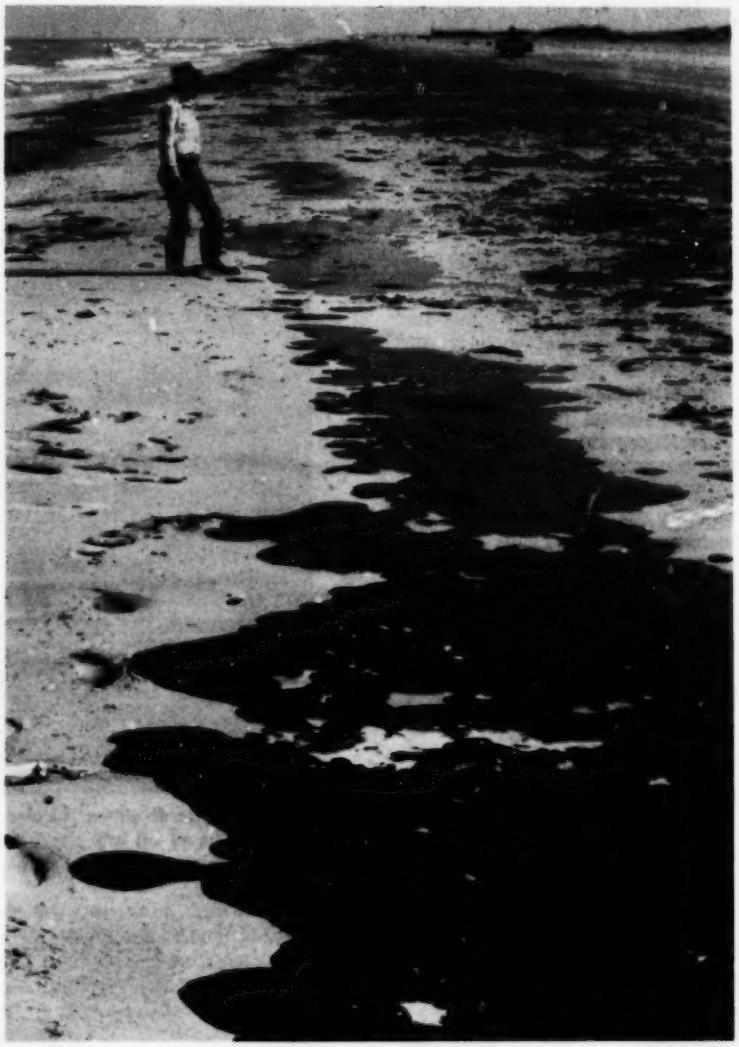
3. To oversee the collection and treatment of oiled birds. The public demands that FWS actively pursue this activity.

4. To provide the news media and the general public with information on fish and wildlife concerns during spills. FWS shares the responsibility with all agencies involved in spill response to provide accurate, timely information.

For additional information on FWS pollution response involvement, contact:

Columbus Brown
National Pollution Response Coordinator
Division of Ecological Services
U.S. Fish and Wildlife Service
Washington, DC 20240

**Oil from the IXTOC well blowout came ashore on almost 200 miles of Texas beaches. Numerous FWS personnel have participated in the planning, response, and damage assessment activities associated with this oilspill.**



**General Size Classes of Oil Spills**

| Size | Inland Waters (in gallons) | Coastal Waters (in gallons) |
|---|---|---|
| Major | 10,000 or greater | 100,000 or greater |
| Medium | 1,000 to 10,000 | 10,000 to 100,000 |
| Minor | less than 1,000 | less than 10,000 |

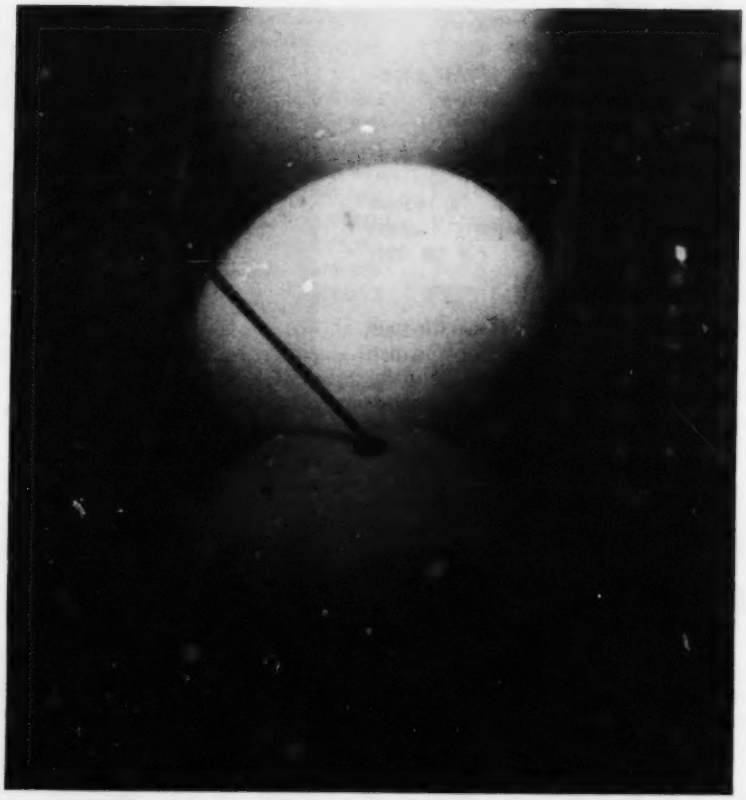
# Effects of Petroleum on Aquatic Birds

Most of the oil that reaches the aquatic environment is released during routine operations, rather than from spills, with an estimated 6 million metric tons of oil polluting the world's oceans annually. The long term environmental effects of sublethal, low-level oil pollution may be more detrimental to bird populations than the spectacular bird kills resulting from oilspills.

Scientists at the Patuxent Wildlife Research Center are studying the ecological, physiological, and toxicological effects of oil on aquatic birds. Their research projects have included the effects of oil on the hatchability of eggs and the effects of oil-contaminated diets on the physiology, reproduction, and survival of aquatic birds.

Very small quantities of oil applied to the eggs of aquatic birds in the laboratory caused embryo mortality. As little as 5 microliters (about one drop) of crude oil applied to the shell surface on the 8th day of incubation reduced hatching of mallard eggs by as much as 90 percent. No embryos survived the application of 50 microliters of any of the five oils tested (South Louisiana crude oil, Kuwait crude oil, Prudhoe Bay crude oil, No. 2 fuel oil, and Bunker C fuel oil).

Oils contain a mixture of hydrocarbons of two general types—aliphatics (paraffins) and aromatics. The aliphatic hydrocarbons are generally less toxic than the aromatics, a belief that was verified in the egg studies. When the shell surfaces were coated with 50 microliters of an aliphatic mixture, embryos did not die.



**Trace amounts of oil on mallard eggshells killed developing embryos. Here, 5 microliters of oil are applied to the surface of an egg. This amount reduced hatching success by 43 percent.**

This showed further that the mortality produced by crude oil did not result from closing the pores in the egg shell through which the embryo receives oxygen.

The toxicity of various oils to embryos is not confined to mallards. For example, mortality was 26 percent in 16 clutches of naturally incubated common eiders treated in the nest with 20 microliters of No. 2 fuel oil and opened 7 days later. Mortality was 60 percent among 25 clutches of great black-backed gulls similarly treated. Embryos of both species are approximately twice the size of mallard embryos, and those tested were of mixed ages at the time of treatment. Variations in toxicity from that demonstrated for mallards can be attributed to differences in embryo size, which changes the dose-to-weight relationship, and differences in ages of embryos at treatment. (Younger embryos are more sensitive.) Mortality was 100 percent in 8-day-old mallard embryos that

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# Contaminants in Dredged Material

Dredging is the removal of accumulated sediment from the bottom of lakes, rivers, and coastal areas in order to deepen the water for navigation or construction. Dredging and disposal of the dredged material (called spoil) can have potentially serious environmental impacts. Aquatic habitat for fish and shellfish and wetland habitat for wildlife can be physically destroyed by dredging and disposal of dredged material in water or low terrestrial areas. In addition to physical destruction of habitat, the other major environmental concern is the release of toxic contaminants from sediments disturbed by dredging or dumped into dredged material disposal areas.

Many pollutants, including pesticides, heavy metals, and polychlorinated biphenyls (PCB's), can bind to sediment particles and settle to the bottom of lakes, rivers, and coastal areas. When the sediments are disturbed by dredging, the pollutants may be released into the water column or into terrestrial disposal areas where fish and wildlife can be exposed to the contaminants. Some of these contaminants may be acutely toxic, while others can accumulate in tissue without acute toxicity, but with potentially serious consequences for higher trophic levels (biomagnification).

The U.S. Army Corps of Engineers administers the issuing of permits for the disposal of dredged material. The Fish and Wildlife Service (FWS) recommends to the Corps of Engineers whether a permit should be issued for a dredging or filling operation. These recommendations fulfill FWS responsibilities under several laws enacted by the U.S. Congress, including: the Fish and Wildlife Coordination Act of 1958, the National Environmental Policy Act of 1969, the Estuary Protection Act of 1968, the Rivers and Harbors Act of 1899, and the Clean Water Act of 1977.

Previously, FWS was concerned primarily about the destruction of habitat due to dredging or filling operations. Now, Environmental Contaminants Evaluation scientists are evaluating the extent of contamination caused by dredging and disposal of polluted dredge spoils.

At the FWS Great Lakes Fishery Laboratory, research is underway to assess the effects of contaminants in dredge spoils on fish. In this study, fish are exposed to contaminated sediments from a simulated dredging operation. The bioavailability of contaminants to the fish is determined by measuring pollutants that have accumulated in the fish after an exposure period of 10 days. Contaminants detected thus far are PCB's; metals, including nickel, chromium, and mercury; and industrial petroleum-related compounds. The fish appear to accumulate these contaminants either through direct uptake of the pollutant from the water and sediment or indirect uptake through the food chain. These studies will also evaluate the hazard to fish exposed to these contaminants and the conditions under

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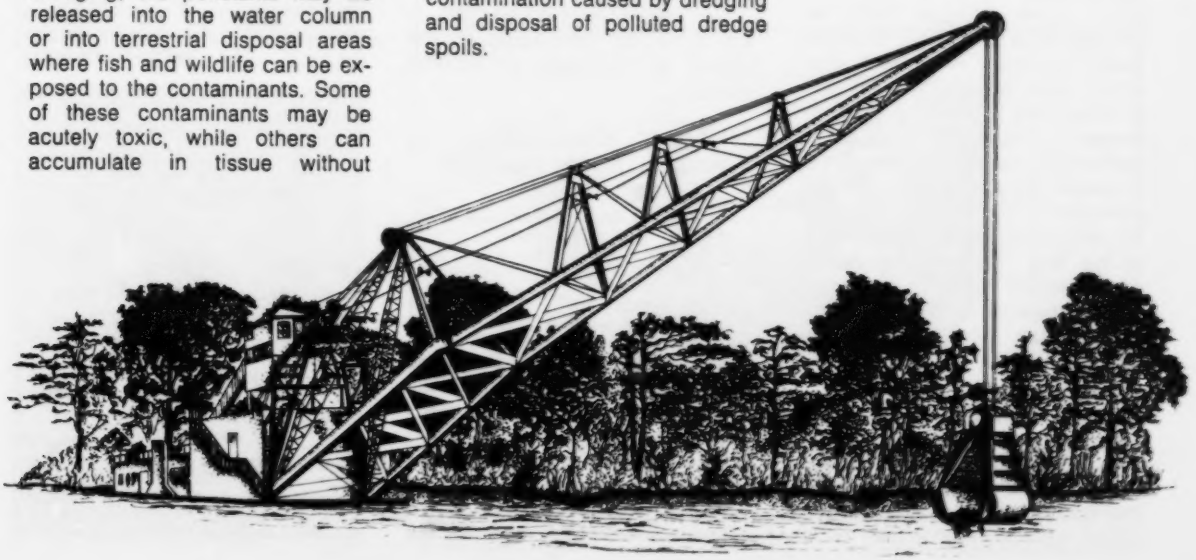

**Effects of Petroleum**
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were treated with 20 microliters of No. 2 fuel oil and artificially incubated.

The minute quantities of oil that produced marked reductions in embryonic survival suggest that oil pollution could seriously affect marine and estuarine birds by the transfer of oil from the plumage of incubating birds to their eggs. Fish and Wildlife Service scientists captured laughing gulls at their nest sites in Texas to examine this possibility. Forty-two gulls were treated with oil applied to feathers over and around their brood patches; 20 additional birds were treated with water. All were released immediately after treatment. After 5 days, the eggs of both groups were collected and examined. Embryo mortality was 41 percent in the eggs incubated by the oiled gulls, but only 2 percent in those incubated by the water-treated gulls.

Other indications of toxicity include teratogenic effects (production of malformed offspring) when oil is applied to eggs during the first few days of embryo development. Treatment of mallard eggs at 24 hours of development with 5 microliters of crude oil produced a significant number of malformed survivors. The most common abnormalities included deformed bills, incomplete wing or foot bones, reduction in size of the liver lobes, and stunting. Teratogenicity was increased when vanadium, nickel, and mercury (metals normally found in petroleum) were added.

To study the effects of oil ingestion on the physiological condition and survival of birds, scientists added oil to the diet of adult mallard ducks. The concentrations added were no higher than birds would ingest under natural conditions. All birds maintained their body weights and ate as much food as did the controls. No mortality occurred, and it appeared that adult waterfowl could survive high concentrations of petroleum hydrocarbons in their diet when not otherwise stressed. Mallards died, however, when they were given seawater as drinking water and were subjected to mild cold stress while being fed oil-contaminated food.

Further, mallard hens fed an oil-contaminated diet for 6 months produced half as many eggs as did control hens. However, the eggs that were laid by the oil-dosed birds hatched as well as did the control eggs, and, at hatching, the ducklings weighed as much as did the controls.

Young mallards (ducklings) that were given oil-contaminated food were stunted and failed to develop flight feathers. They were more seriously affected than adults, possibly because they were in a critical phase of development when they should have been growing rapidly.

For additional information on the effects of petroleum on wildlife, contact:

Lucille F. Stickel, Director
Patuxent Wildlife Research Center
U.S. Fish and Wildlife Service
Laurel, MD 20811

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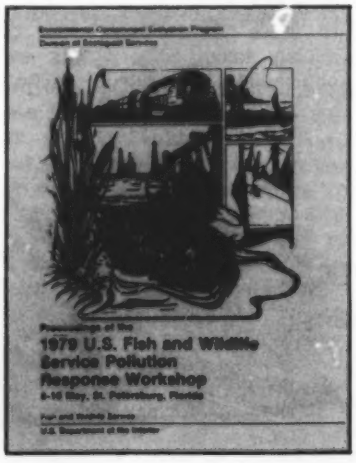
which release of contaminants and bioaccumulation occurs. FWS is one of several Federal agencies working on environmentally acceptable ways to dispose of polluted dredge spoils. Other agencies include: the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the National Marine Fisheries Service, the Corps of Engineers, and various State agencies.

For more information about FWS involvement with dredging and dredged material disposal, contact:

David F. Walsh
Division of Ecological Services
U.S. Fish and Wildlife Service
Washington, DC 20240

# Product Reviews

Effective response to oil and hazardous substances spills requires a coordinated, interdisciplinary approach. At the FWS 1979 Pollution Response Workshop, personnel representing Federal, State, and local agencies met with representatives of industry, private groups, conservation and humane organizations, and academicians to exchange ideas on spill response. Presentations at the workshop have been compiled into a single volume entitled



**Proceedings of the 1979 U.S. Fish and Wildlife Service Pollution Response Workshop.**

This volume includes the following topics: (1) introductory material and a definition of the spill response problem; (2) elements of Federal, State, and local government and industry response to pollution discharges; (3) biological and physical impacts of oil and hazardous substances; (4) spill response techniques, including containment technology and wildlife rehabilitation; (5) interaction with the public, news media, and other agencies in crisis situations; and (6) documentation of spills and environmental damage for purposes of litigation and the development of new prevention strategies.

The **Proceedings** is intended as a reference volume for FWS personnel and others who are concerned about or involved in responding to oil and hazardous substances spills. Those who use this volume should be equipped to respond more efficiently and effectively to future oil and hazardous substances spills.

Copies of the **Proceedings** can be obtained from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
Stock No. 024-010-00531-9
$5.50

The role of submerged aquatic plants in the Chesapeake Bay ecosystem is of great concern because these grasses are rapidly declining. These aquatic plants provide essential habitat for many animal species and are important primary producers that form the basis for food webs in the bay. Some ducks, fish, shrimp, and snails graze directly on the living grasses; clams and oysters feed on the dead plant tissue.

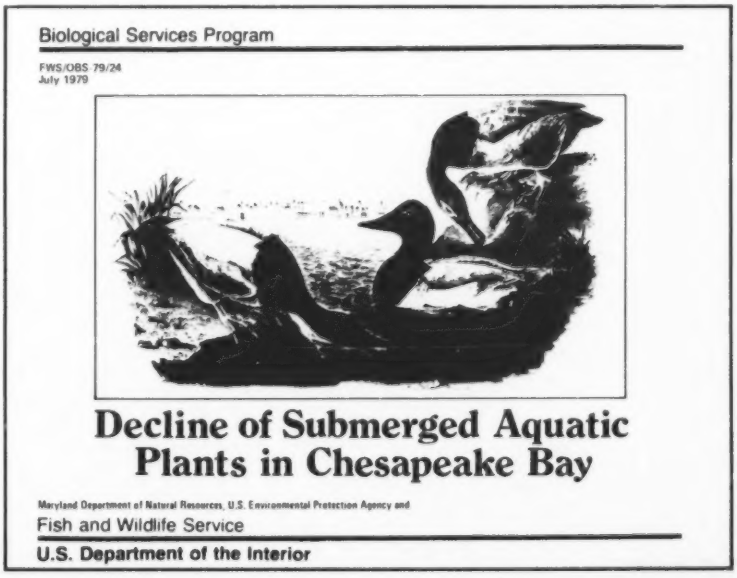
A Biolgical Services Program brochure entitled **Decline of Submerged Aquatic Plants in Chesapeake Bay** covers subjects such as what species comprise the bay grasses, why these grasses are important, and why they are diminishing. The authors of this brochure indicate that the most likely natural stresses on the grass system are: overgrazing by animals, effects of Hurricane Agnes, warming trends of bay waters, and natural disease.

Man-induced stresses include the introduction of pollution, including point and nonpoint sources; industrial or municipal sewage treatment plants; malfunctioning septic systems; runoff from agricultural lands; and runoff from urban/suburban development.

Some bay grasses—Eurasian watermilfoil, Redhead grass, Sago pondweed, Widgeongrass, and Eelgrass—have been studied since 1971. Scientists continue to seek answers for the recent decline of the bay grasses.

Copies of the brochure (FWS/OBS-79/24) can be obtained from:

National Coastal Ecosystems Team,
Information Transfer Specialist
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
Slidell, LA 70458


Biological Services Program
FWS/OBS 79/24
July 1979
Decline of Submerged Aquatic Plants in Chesapeake Bay
Maryland Department of Natural Resources, U.S. Environmental Protection Agency and
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# The Bulletin

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